State of California

Memorandum

DRAFT

Department of Health Services

Date: June 24, 1998

To: Gary Yamamoto

From: Rick Sakaji

Subject: Comments on DRAFT "Phase 1 Treatability Study Draft Report Perchlorate in Groundwater Baldwin Park Operable Unit San Gabriel Basin" by harding Lawson Associates

I apologize for the rough and incoherent listing of comments on this report, but I thought you'd like to see something rather than just discussing the issues over the phone. If you have any questions regarding any of these comments please feel free to contact me.

1. Report is well organized and thought provoking.

2. Visual inspection is a good tool, but is far too subjective to be the sole basis for any decision making. Observations are an essential element of any decision making process relating to process operation, but must be recognized as a qualitative element.

3. On page 8 the report notes that chlorate was detected when perchlorate and nitrate destruction were incomplete. What sort of concentrations did they encounter?

4. There is very little discussion regarding the solids side of the treatment process. The bulk of the discussion centers on the removal of perchlorate from the bulk solution. This is not inappropriate, as the goal of the treatment process is to remove or destroy the perchlorate. However, any utility contemplating the use of a biological process should consider the impact of a solids handling operation in their plans.

5. Solids are an important component of this treatment process. The biomass is responsible for using the nitrate and perchlorate as an electron donor thereby facilitating the oxidation and ultimately the removal of perchlorate. Again what this analysis and report concentrates on are the bulk solution parameters (ORP, pH, etc.) and not enough analysis is spent on the biomass residence time (mean cell residence time).

6. In my limited review I did not note that steady-state operating conditions had been reached. This brings up the question of whether or not the biological population had a chance to stabilize before the conditions of operation were changed. I would think that at least 3 to 5 residence times would need to pass before stable operation could be assumed. In this case residence time does not refer to the hydraulic residence time of 4 to 22 minutes, but the residence time of the biomass (which I could not find in the report) to ensure "stability" of the biological population. They noted on page 12 that it generally took 2 days or longer to reestablish complete destruction at the next higher flow rate (I assume this is at high DO levels) and that at least 5 days was allowed to pass before determining if optimum performance had been achieved.

Several days were needed to recover the system. Even under planned power outages bioreactor performance required at least 24 hours to reestablish performance (I would like to see the ORP readouts during these times and their correlation with reactor performance).

This is especially troubling for a groundwater system that contains or no distribution system storage. Any upset in the biological reactor could leave the system without water for an extended period of time, unless sufficient storage to provide some sort of backup was supplied along with a performance guarantee. Their phase II studies should include operation, under optimal conditions for the bioreactor, with a typical and worst case water demand scenario placed on the effluent from the bioreactor. (Also note that the age of the organics may also influence DBP production).

The startup and shutdown procedures for the bioreactor need to be detailed for the operations manual.

7. It would seem to me that operational parameters like food to microorganism ratios would be important for evaluating critical issues like minimum substrate or nutrient levels.

8. It would also be interesting to see a tracer study of their reactor, with and without recycle, as the equation on page 6 is for a reactor in plug-flow. With recirculation and due to the tower and solids handling unit, the hydraulic character of this reactor will lie between a completely-mixed tank reactor and plug-flow reactor.

9. I am concerned that the levels of methanol may raise some questions. The 5 mg/L detection level may not be sufficient to detect concentrations of methanol that may be of a health concern. We should wait to see if the ethanol receives NSF approval as a drinking water additive. This will take care of one problem associated with the use of ethanol as a carbon source.

10. The problem with ethanol, as has been noted before, is a cultural one. Those ethnic or religious groups that abstain or do not condone the use of alcohol may object to having this substance added to their water supply, in part, because no one can provide them with a guarantee that the substance will be removed before the water reaches their taps. However, this is a problem that the utility will need to face and reach a decision on because, unless the problem is health related, I don't believe we have the authority to prevent its use. Informally OEHHA has already indicated that they do not see a major problem with the use of ethanol at these low concentrations (see attachment).

11. The report states that little or no sensitivity to temperature was observed. Books such as those cited in their own reference list do indicate that coefficients used to model biological reactors follow an Arrenhius type of temperature dependence. It is not surprising that no sensitivity to temperature was observed as the short time frame of

these experiments and continual changing of variables may have masked any influence of temperature.

12. In the executive summary (last bullet) and the last paragraph on page 13, the phrase "These results demonstrate that with disinfection and filtration..." should be rewritten. These studies were not conducted with disinfection and filtration on the finished water, but, based on chemical monitoring data, indicate that with the ***addition of*** disinfection and filtration the water produced will meet potable standards. This means that a filtration and disinfection system, equivalent to what is required to meet Surface Water Treatment requirements is the minimum that may be required.

    As was discussed in previous meetings with Aerojet and HLA, some work on DBP production needs to be conducted. We should be concerned that the presence of low molecular weight compounds (ethanol and methanol) may result in significant DBP production when strong oxidizing agents (chlorine) are used to disinfect the water.

13. They state that their conceptual model agrees well with actual results, but I don't understand the basis for this conclusion. They provided a model, but their discussion did not provide an indication of how the model was being used, how the parameters for the model were derived, what the values of the model parameters were, and how the well the model predicted changes in reactor performance.

14. I think their need for an increased recycle rate results in a long mean cell residence time, typical of biological nitrification systems.

15. I would agree that ORP shows promise, as may pH, but these are measures of performance in the bulk solution. What is more important to the microorganisms is the environment on and around the carbon particle and in the biofilm. A change in the bulk solution may allow time to respond to changes in the microecology of the biofilm and may result in substandard water quality. I think we can discuss with them the need for tighter monitoring for the next phase of study. From their comments on page 12 regarding the ability to reestablish bioreactor performance in 24 hours, I would ask the water utility if they could survive without water production from this system for 24 hours or longer.

16. Aside from the stoichiometric equations for substrate utilization I would like to see information on cell yields and an attempt to close a mass balance on the perchlorate, i.e., to account for where it is going. Since no other QA/QC results were summarized, a mass balance would be a good way to build confidence in the results and their ability to identify the pathways of removal.

17. Their application of Voltera's principle for their bioreactor is interesting, but as they note, only speculative as they did no species identification. I'm not sure that extinct is the correct term in this context. They state that 4 to 5 independent species thrived at various times in the reactor. I assume that this means different species, if so, how were the new species introduced to the reactor? If not, this means the other species

were present, but not in significant numbers. Could it also be the same species reacting to different environmental conditions? Bacteria are noted for changing their morphological character based on the environmental conditions. Besides, bacteria can repress certain enzyme systems under certain conditions, until they are needed to achieve a competitive advantage.

18. It should be made clear to Aerojet and HLA that DHS does not provide an operating permit to consultants or companies unless they are the parties responsible for operating the potable water supply system (including the distribution). No permit will be issued until ***all*** questions have been formally responded to as part of a written record. Issuing a permit is not contingent upon meeting project goals, deadlines, or deliverables. Issuing the permit requires the water purveyor to provide a scientifically defensible engineering report on the performance, control, maintenance, and operation of the treatment technology.

19. Their sampling program (number of samples, frequency of sampling events) for phase II should be based on the results of phase I. We should be able to feel confident (95% confidence level) that a difference of 10% in any of their operational parameters could be determined to be statistically significant.

Sorry for the hasty nature of these comments, but it was all I could muster in the time available. Call me if you have any questions.

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